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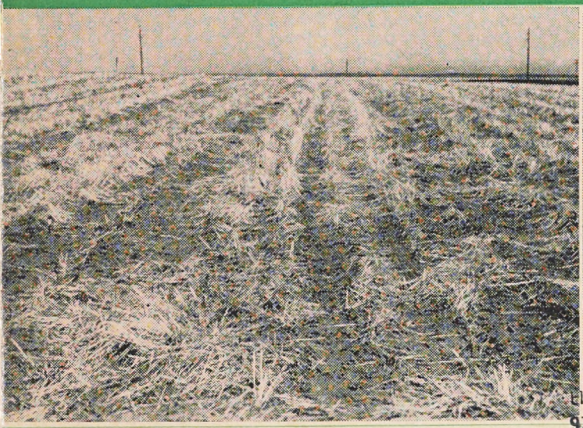
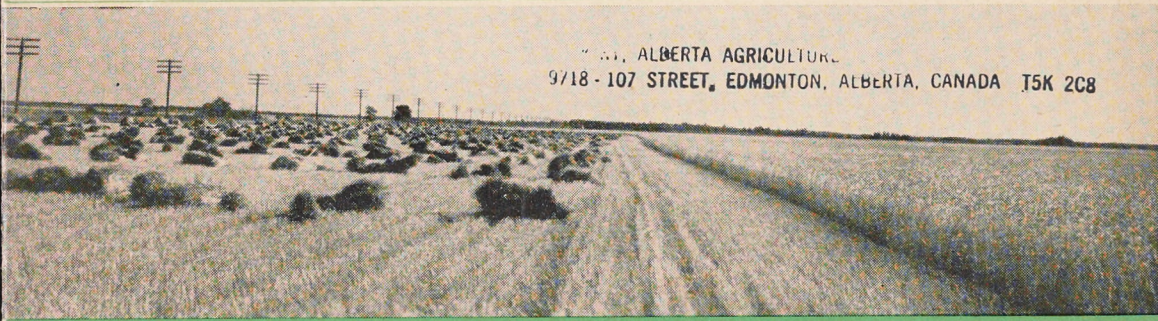
PROTECT PRAIRIE SOILS



Protection

MEANS

Production



LINE ELEVATORS FARM SERVICE

WINNIPEG, MANITOBA

Circular No. 19 (Revised)

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Protect Prairie Soils

By H. J. MATHER,
Assistant Director, Line Elevators Farm Service, Winnipeg.

INTRODUCTION

The three fundamental requirements of man are food, clothing and shelter, all of which come from the soil. Thus it is obvious that the indefinite continuance of human life upon the earth is conditioned by the wise use of the soil, that is, by its sound management, its adequate fertilization and, most of all, by its continuous protection. One of the greatest problems confronting the world today is to feed an ever-increasing population from steadily diminishing soil resources.

One after another, the great empires and civilizations of the past have been swept out of existence by soil erosion. As a result of human mismanagement the soils of the New World, upon which men have attempted to build new civilizations, are disappearing at a rate and on a scale unparalleled in history. In the United States, for instance, soil erosion has already ruined 50 million acres of what was once good agricultural land. Another area of crop land, approximately 100 million acres, is rapidly approaching the same condition, and a further 100 million acres have been seriously affected by soil erosion. It is estimated that the direct monetary cost of erosion to farmers in the United States is not less than $400 million a year.

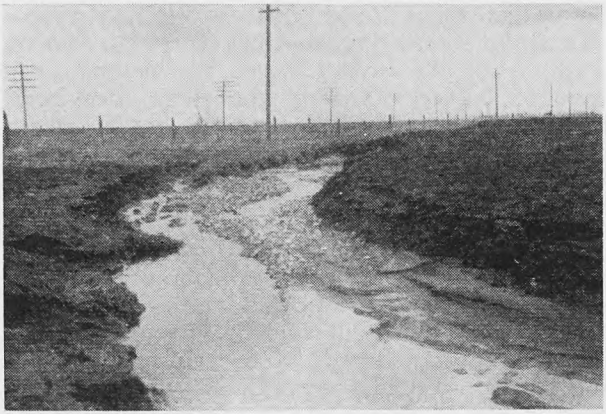
Such disastrous losses of productive land are, of course, not confined to the United States. Through unwise land management and use, millions of acres of good crop and grazing land in the Prairie Provinces have already been ruined or severely damaged by wind and water erosion. The marked effect of erosion in reducing the yield of grain crops has been emphasized in soil studies made in recent years at the Lethbridge Experimental Station. For instance, in 1953, a very favorable crop year, soil at the Lethbridge Station that had been seriously eroded by wind during the "dry thirties", produced only 12.8 bushels of wheat per acre; whereas protected, undamaged soil in the same field yielded 30.2 bushels per acre. Experiments conducted on other Experimental Stations in Western Canada, as well as the experience on many farms throughout the prairies, have clearly shown that the removal of vital topsoil by wind and water erosion has drastically reduced the productivity of the soil. The problem of soil erosion has already become a dominant factor in the agricultural prosperity of this country.

The reduction in the productive capacity of the soil, however, has been offset, to some extent at least, by the introduction of new high-yielding varieties of crops, improved cultural machinery, effective weed control chemicals and the use of commercial fertilizers. The loss of vital topsoil, however, is no less a tragedy. And if it is allowed to continue a point will eventually be reached where an impoverished soil will refuse to produce in spite of the introduction of improved varieties and cultural methods. Once the organic matter has been removed, the soil will refuse to produce.

Today, through erosion, the soils of Western Canada are disappearing at an alarming rate. Without the immediate establishment of permanent safeguards for our productive land, there can be no permanent agriculture in this country; and without a permanent agriculture the Prairie Provinces can hardly be expected to continue a vigorous, progressive existence. In other words, the wealth of Western Canada is in her prairie soils and her future lies in their intelligent management and protection.

Soil Erosion

CAUSES OF EROSION



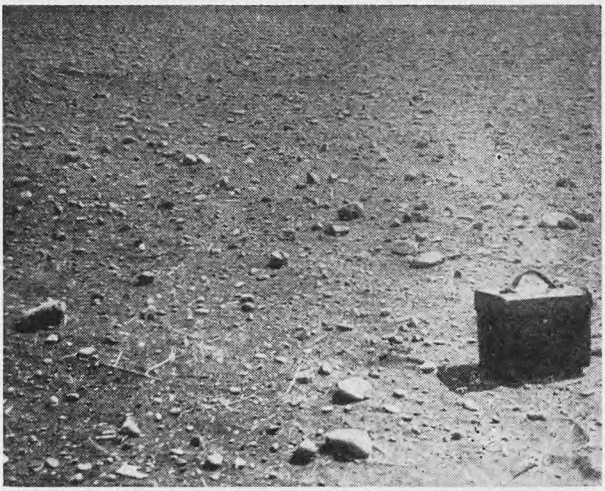
SEVERE WATER EROSION

Wind and water are the active forces of soil erosion. However, although they differ in the nature of their action they are similar in that both remove soil from the surface of the land. Wind erosion or soil drifting occurs during dry windy periods while water erosion occurs during heavy rains or spring run-off. Erosion by wind and water occurs on soils which lack surface protection and which have had the fibre and organic matter destroyed through repeated croppings and tillage.

When the white man first settled the Western Plains the soil was covered with grass or forest. The water in the streams was clear, indicating that little erosion was taking place. As settlement increased, more and more sod was broken and large forested areas were cleared by axe and fire to yield more land for the production of food. Before long, as a result of unwise land-use practices, dust storms, gullied fields,

and muddy, silted streams revealed the loss of precious topsoil through wind and water erosion. With the passing of time, dust storms became more and more frequent and more severe, until, in the dry 1930's, the Prairie Provinces were faced with a widespread soil-drifting calamity. Furthermore, rills and gullies became increasingly common in cultivated fields, indicating that water erosion also was developing into a major problem. The removal of the native grass and forest cover, together with the ruthless destruction of soil fibre and organic matter, through repeated and improper cultivation, paved the way for accelerated soil erosion. Waste of natural resources in this country have nowhere been more glaring than in the careless use of our prairie soils.

EFFECTS OF EROSION



SEVERE WIND EROSION

Erosion, either by wind or water, may be an extremely rapid or a very slow process. Fields may be blown bare to the subsoil by one or two wind storms, or only a small amount of topsoil may be lost each year through wind erosion. Similarly with water erosion much of the topsoil may be lost from a field in a single heavy rainstorm, or only a small amount of soil may be lost yearly through sheet erosion. Whether the loss of soil be great or small it is a very real and permanent loss.

The reduced yield on eroded soil is due to two things. First, the loss of mineral elements which growing plants require. In this regard it is estimated that the plant food elements contained in one inch of topsoil lost through erosion represents enough plant food to grow some twenty average cereal crops. Second, there is the loss of organic matter. It is impossible to put a dollar value on this important component of the soil. Organic matter enables a soil to absorb and retain water. It ties the fine mineral particles in the soil together and thus improves the physical condition or tilth of the soil. This is important in preventing erosion. It feeds the micro-organisms in the soil and enables them to change inert forms of mineral elements into forms which the plant can utilize. Without organic matter the soil would be simply a mixture of sand and clay with little ability to produce a crop.

Briefly, then, erosion reduces not only the mineral elements in the soil, but through the loss of organic matter reduces the ability of the soil to absorb and retain moisture and to manufacture plant food.

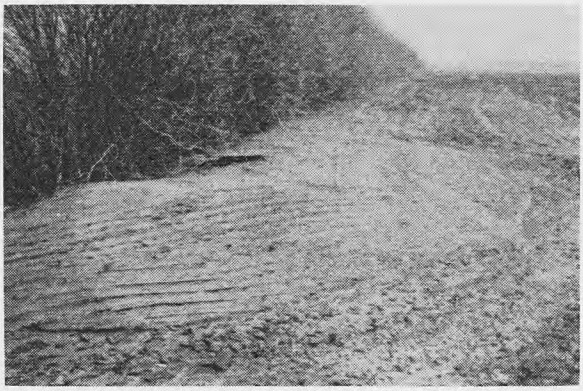
WIND EROSION

Wind erosion or soil drifting is the movement of soil by the action of wind. During this process there is a considerable sorting or grading of the soil particles. The finer particles of silt, clay and organic matter are removed from the soil, while the coarser sand particles remain behind. Careful soil tests have shown that the material blown away during dust storms, contains 10 times as much organic matter, 9 times as much nitrogen and 19 times as much phosphorus as the sand dunes left behind. Hence to prevent the loss of the topsoil the control of soil drifting, even on a small scale, is imperative.

As early as 1920 soil drifting was a serious problem in southwestern Alberta. Even before the occurrence of the "dust-bowl" conditions of the "thirties", farmers in the Monarch-Nobleford area of Alberta were using effective means of controlling soil drifting. By tilling their fields in narrow strips and by utilizing every scrap of stubble and weed growth to form a trash cover, they were able to protect their fields from wind erosion.

CONTROL PRACTICES

Field Shelterbelts. Where soil drifting is a constant threat, and particularly in areas of very light or very heavy soils, the planting of field shelterbelts can assist greatly in reducing this hazard. The amount of protection provided by a shelterbelt depends on the height of the trees. Field tests have shown that a shelterbelt will reduce the velocity of the wind by approximately one-half for 10 times its height to the windward side and 20 times its height to the leeward side. On large open areas a series of shelterbelts will, of course, be necessary.



UNPROTECTED FIELD SHELTERBELT

PROTECTED FIELD SHELTERBELT

Field shelterbelts can assist greatly in reducing wind erosion. However, they should not be relied upon to solve the whole problem.

Trash cover and strip farming should be used in conjunction with any field shelterbelt program. If this is not done there is grave danger of the shelterbelt being buried by drifting soil. This could mean a ruined shelterbelt and a troublesome ridge of soil through a field.

Strip Farming

The manner in which strip farming acts to reduce soil erosion may be described briefly as follows: Soil drifting spreads rapidly on a bare field due to the scouring action of wind-borne soil particles. These particles are picked up by the wind, carried for some distance, and then fall. When they strike bare soil they loosen other particles. These in turn are carried by the wind, strike more soil particles which are in turn broken loose, thus increasing the scouring action. Where a field is farmed in alternate strips of crop and fallow, the cropped strips filter out the soil particles from the wind. In this way the scouring action, if not entirely eliminated, is greatly reduced. Alternate cropped strips have proved to be very effective in preventing wind erosion over large areas of cultivated land.

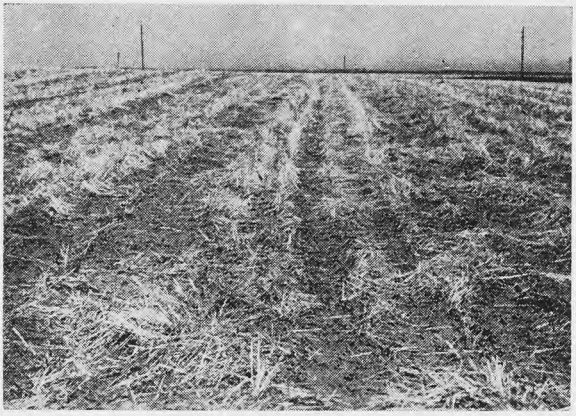
While strip farming is a valuable aid in preventing soil drifting it alone should not be relied upon to control this form of erosion. It is very important that drifting be kept to a minimum on the non-cropped strips. If drifting occurs on these strips the air-borne soil will be deposited in the crop. Thus the cropped strip is built up by drift soil as the non-cropped strip is lowered by soil removal. The final result is a series of ridges and hollows over the field.

The Trash Cover

Trash cover is recommended for five sound reasons:

1. It is effective.
2. No additional cost to the farmer is involved.
3. No major change in the existing farm program is required.
4. A considerable amount of plant food is returned to the soil.
5. It helps maintain esential soil organic matter.

Experience has shown that to make the best use of the trash on a field the plow had to be discarded, and surface-tillage machines substituted. The blade machines, the duck-foot cultivator, the new high-clearance cultivator, the rod-weeder, the one-way disc and the recently introduced wide-level discer are now the recommended implements for the cultivation of soils that are subject to erosion.



A GOOD TRASH COVER

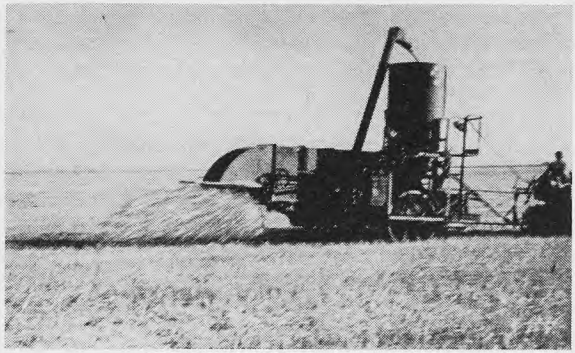
In dry years, when crop growth is sparse, the problem of maintaining a protective cover on fallow fields is difficult. Under dry conditions extreme care must be exercised in the operation of tillage implements to preserve all available stubble and weed growth as a trash cover. Slowing down the speed at which implements are operated is essential. High speeds either bury the trash, or throw it out on the surface where it may be easily blown away. In addition, high speeds destroy soil fibre and soil structure. The ideal trash cover has straw, stubble and weed growth firmly anchored **in the surface soil.** Cultivation needs only to be deep enough to make a "clean cut" at each operation in order to destroy weed growth.

Another point worth remembering is that stubble which is left standing erect will provide a great deal more protection to the soil than the same quantity of material lying flat on the soil surface. The object of a trash cover is to reduce the velocity of the wind, at the soil surface, to a point where it will no longer move soil particles. A standing stubble is naturally more effective than one which is flat on the ground. The use of cultivator or blade-type machines will leave the stubble more erect than will disc-type implements.

Straw Spreader Important. The efficiency of the straw spreader on the combine will, to a considerable extent, determine the ease or difficulty with which trash can be handled. If the straw has been spread uniformly, little difficulty should be encountered, whereas if it has been left in bunches or windrows, trouble is almost bound to occur. Dry straw, which has been spread evenly, is not difficult to handle with the one-way, the discer or the duck-foot cultivator. Wet straw, on the other hand, is difficult to work with rolling disc machines, and will "plug" a cultivator very readily.

Straw Cutters. During the past few years various types of "straw cutters" for attaching to the combine have appeared on the market. Some are of simple construction, quite effective, and require little power

to operate. Others are complicated and require so much power to operate that they affect the threshing efficiency of the combine. The efficiency of a straw cutter should be determined not by its ability to cut the straw into very short lengths, but rather by its ability to spread the straw uniformly behind the combine. Where crops are heavy, and trouble is encountered in handling the resulting trash, an efficient straw cutter is well worth considering.



STRAW CUTTER AT WORK

Choice of Implement. The choice of implement is extremely important in handling trash cover. The one-way disc, if operated at low speeds and at a shallow depth, is usually quite satisfactory for the first operation. However where there is only a small amount of trash present a better practice is to use a duck-foot or blade machine. These implements, if properly used, will make the best possible use of the limited amount of material present and produce an efficient soil cover.

Handling Trash on Fallow Land. Some farmers, even in areas where large quantities of trash are present, find it difficult to preserve adequate trash cover throughout the fallow year. Some of the reasons for this are: too deep cultivation, operating at too high speeds, and too frequent cultivation. These apply particularly where the one-way is used almost exclusively in the fallow operations. The speed of travel with the one-way or discer should not exceed 3½ m.p.h. The use of the duck-foot cultivator, blade machine or rod-weeder in place of a disc machine, for at least some of the fallow operations, will help conserve valuable soil cover.

Handling Trash on Land to be Cropped. Where a very heavy covering of straw is present in the Fall, on land to be cropped the following year, it is often advisable to break up the straw as soon as possible after harvest. If the straw is dry, one or two strokes with the drag harrow or the oscillating harrow at a fairly fast speed will do much to break up and spread the straw. This will make it much easier to cultivate and seed the field the following Spring.

Seeding Trash-Covered Land. In many cases it may not be necessary to cultivate trash-covered land prior to seeding. Such land is usually seeded with a tiller-combine or discer with seeder-box attachment. In certain cases, however, it may be necessary to cul-

tivate at least once before seeding. In most areas where heavy crop residue occurs the most satisfactory machine for pre-seeding tillage is the one-way or discer. Blade machines are excellent in areas where soil and moisture conditions permit their use.

While low speeds and shallow cultivation are recommended at all times, they are particularly important where the field is to be seeded almost immediately after being tilled. Slow, shallow cultivation will keep the stubble anchored in the surface soil, and leave most of the straw on the surface. High speeds and deep cultivation mix a great deal of the crop residue into the soil, and often produce a loose, dry layer of soil at seeding depth.

If the trash is handled as described above there should not be too much difficulty in planting the field with a seed drill. If the trash is extremely heavy, and difficulty is encountered in obtaining proper penetration with the seed drill, the logical alternative is to seed with a one-way or discer equipped with a seeder box. Packing land seeded with either of these machines is strongly recommended.

Trash on Steep Slopes. It has been clearly demonstrated that the use of adequate trash cover will greatly reduce soil losses from water erosion which occur on level or slightly rolling land. It is also capable of reducing appreciably the loss of soil from sloping fields. The trash cover alone, however, cannot be expected to completely control erosion on steep slopes. And even on gentler slopes where the soil has become clogged and puddled through years of exposure and tillage, the trash cover alone is not sufficient. Here the basic structure of the soil has been destroyed, and its water holding capacity greatly reduced through puddle erosion. A description of puddle erosion will be found on pages 13 and 14.

Trash Cover Can Reduce Yields

Straw and stubble mixed into the soil are decomposed or "rotted down" by the soil organisms. During the rotting process these organisms use up nitrogen which might otherwise be available to the growing crop. This may cause a reduction in yield. The greatest reduction in yield usually occurs when a large quantity of straw, etc., is mixed into the soil to a depth of 3 to 5 inches and the seed placed in this mulch. The straw tends to keep the soil loose and open with the result that it dries out readily. Under these conditions, too, the soil organisms, which rot the straw, are concentrated in the same layer of soil as the growing plant and compete with it for moisture and nitrogen. Crop yields are certain to suffer from such competition. On the other hand, if the trash cover is kept near the surface, so that the seed can be placed below it in firm soil, little if any reduction in yield is likely to occur.

Preventing Yield Losses from Trash Cover

Use of Fertilizers. The use of a high nitrogen fertilizer, such as ammonium phosphate 16-20-0, at a fairly heavy rate is often advantageous where a heavy trash is present on a field. The nitrogen so applied offsets that used by the soil organisms in rotting down the trash. Increased yields usually follow the use of fertilizer.

Sweet Clover Valuable. The most serious problem in connection with trash cover often occurs when a second crop is grown after fallow. Usually large quantities of nitrogen are used by the heavy fallow crop and a great deal of trash remains on the field after harvest. Thus, in the second year, the soil organisms which decompose this heavy trash and the growing crop are competing for a limited supply of nitrogen. The result is lowered crop yields.

In order to increase the nitrogen supply and at the same time improve the physical condition of the soil, some farmers seed sweet clover with the crop grown just prior to the fallow year. The sweet clover is worked into the fallow when it is about two feet tall, thus increasing the nitrogen content of the soil. This practice has greatly offset reduced yields often encountered in the second crop after fallow. A fact to be kept in mind, however, is that sweet clover has a tendency to break down the natural clods and lumps of soil thus encouraging erosion. Consequently it is necessary to exercise considerable care in handling land on which sweet clover has been grown.

Fertility Value of Trash Cover

Besides being an excellent protection against wind and water erosion trash cover is valuable in two other ways. The straw and stubble from a 20-bushel crop of wheat, for instance, contains about 17 pounds of nitrogen, 3.2 pounds of phosphate and 50 pounds of potash. When the straw and stubble are burned much of this plant food is lost. It is estimated that at least $2.00 worth of plant food is lost per acre when such material is destroyed by burning.

Possibly a greater loss is in the organic matter destroyed. This loss is hard to measure but we do know that many of our soils are low in organic matter and that organic matter is the life of the soil. Burning of straw and stubble is a ruthless, wasteful practice. It should be avoided at all cost.

EMERGENCY METHODS IN SOIL DRIFTING CONTROL

Even on farms where soil-drifting control measures are constantly practiced some drifting may occur. In cases of this kind it is obvious that some type of emergency control measures will be required. Four practical and effective methods are described below.

Spreading Straw. Soil drifting usually starts on a small area and then spreads. The starting or focal point may be a bare knoll, a small

area of light soil, or a portion of the field which received extra cultivation for weed control. Applying a light layer of straw or manure to such points will often prevent a serious drifting problem. One load of straw will "tie down" a surprisingly large area.

Plowing Furrows. Another effective method to stop drifting is to plow furrows about a rod apart at right angles to the prevailing wind. The soil particles carried by the wind are trapped in the furrows. This reduces "sand blast" action, and often helps to "tie down" the soil over an entire field.

Corn Lister Shovels. Where large acreages are drifting seriously, spreading straw or plowing furrows may not be a practical means of control. Under these conditions the use of corn lister shovels on a duck-foot cultivator is strongly recommended. To equip a duck-foot with lister shovels first remove all duck-foot shovels from the machine. Lister shovels should then be attached to the proper shanks so that they are spaced from 3½ to 4 feet apart. The other shanks should then be tied back or the springs released so that they will not drag in the soil. The timely use of a cultivator equipped with lister shovels can quickly transform a drifting field into a series of ridges and hollows. This is a particularly effective method of controlling drifting on large areas.

A GOOD JOB OF LISTING

Listing with One-Way Disc. The one-way disc can be readily adapted to the job of listing. This is done by removing a sufficient number of discs so that those remaining are spaced 3½ to 4 feet apart. It is necessary, of course, to place enough washers on the gang bolt to compensate for the discs that have been removed.

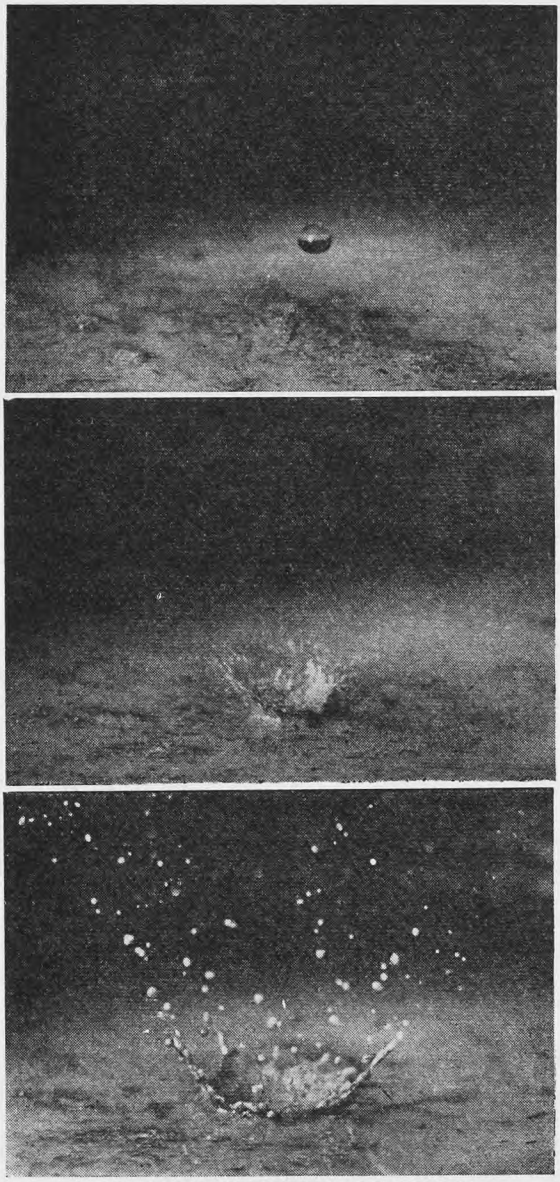
WATER EROSION

As it is a less conspicuous and more insidious type of erosion than that caused by wind, the seriousness of water erosion is often overlooked. The clouds of dust accompanying wind erosion leave no doubt of the movement of soil by the wind. On the other hand, thousands of tons of precious soil may be lost through water erosion with nothing spectacular occurring to warn of the danger.

TYPES

Three principal types of water erosion are generally recognized, namely, sheet erosion, rill erosion and gully erosion. A closer study

of the problem reveals, however, that three other important types must be considered. These are splash erosion, puddle erosion and fertility erosion. A brief description of these erosion types follows.



EFFECTS OF RAINDROP SPLASH

Photo: United States Department of Agriculture

Splash Erosion. Falling raindrops release a terrific amount of energy when they strike the surface of a bare soil. It is estimated that one inch of rain falling on one acre will release energy enough to plow the land 10 times! Each raindrop as it strikes the soil surface causes a small explosion. Soil particles are broken loose and thrown in every direction by the splash. Where this occurs on sloping land most of the movement of the soil particles is down the slope. In this way successive layers of soil may be moved down the slope (sheet erosion) without the help of actual run-off water.

The key to erosion control is to prevent the erosive force of falling raindrops from striking the soil surface. Keep a cover on the soil!

Puddle Erosion. Many of the fine particles of soil loosened by falling raindrops are washed into the soil. These clog the natural open spaces in the soil so that it can no longer absorb or hold moisture as it did before. The natural air spaces are filled, with the result that the soil cannot absorb air freely. These changes in soil structure have a profound effect on crop yield.

There is another important result from puddle erosion. When the soil dries the fine particles on the surface bake into a thin crust. This crust is often called the "shanty roof" because it retards or prevents water entering the soil. When rain falls on a field so covered, it cannot percolate into the soil, and therefore runs off. If the surface soil has been broken down by raindrop splash much soil may be lost.

Fertility Erosion. As mentioned above, falling raindrops break up the clods and lumps on the soil surface and splash them about. The finer, lighter particles of soil — rich clay, silt and organic matter — are brought to the surface. Thus the finer, richer parts of the soil are washed away and the coarser less fertile material is left behind. In actual tests it has been shown that soil removed through water erosion contained as much as 5 times more organic matter, 5 times more nitrogen, 3 times more phosphate, and 200 times more micro-organisms than the soil left behind.

Splash erosion is actually the fundamental cause of all types of water erosion. A brief description of the commonly recognized kinds of erosion follows.

Sheet Erosion. This is actually the result of splash erosion. As the surface soil on sloping land is broken up by splash erosion, successive thin layers move down the slope. The greatest amount of damage is usually at the crest of a hill where less energy is required to move a given quantity of soil.

Rill Erosion. After a bare soil has been exposed to pounding rain its ability to absorb moisture and to resist erosion by flowing water is greatly reduced. Subsequent rains cause a flow of water across the surface of the soil. The water tends to flow in small streams and the result is rill erosion.

Gully Erosion. When water flowing over the surface of the soil attains a certain volume and speed of flow it begins to cut channels or gullies in the soil. The volume and speed required to cause gullying will, of course, vary with different soil conditions and soil types. In other words, some soils erode much easier than others. On the other hand, the erodibility of any soil will vary with the protection given it in the way of vegetative cover and the amount of organic matter and fibre it contains.

PREVENTING WATER EROSION

From the above discussion it is obvious that the problem of preventing water erosion is much the same as that of preventing wind erosion. Protecting the surface of the soil is of primary importance. Surface protection, of course, means protection from raindrop splash.

The trash cover has a real place in water erosion control. It helps in several ways. First, it protects the soil from raindrop splash. Sec-

ondly, the straw and stubble anchored in the surface soil form channels through which rain can enter the soil. Thirdly, it mechanically slows down the rate of flow of water over the soil surface thus both reducing the erosive power of the water and allowing more to soak into the soil. In addition to the above, the trash cover eventually rots down to produce valuable organic matter and humus.

The following figures from an experiment carried out by the United States Soil Conservation Service, show the effectiveness of trash cover in saving moisture and preventing soil loss through water erosion:

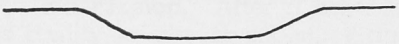
Method of Cultivation	Moisture Stored	Soil Lost
	(inches)	(tons per acre)
Trash Cover	3.78	.97
Bare Fallow	1.03	13.04

As these results show, the loss of soil through erosion was less than one-twelfth as much on the trash-covered field as on bare fallow. Also, that more than three times as much moisture was stored in the trash-covered field than in the bare fallow field. As moisture is a major factor limiting crop production in Western Canada the importance and effectiveness of the trash cover in preserving moisture and reducing soil erosion cannot be over-emphasized.

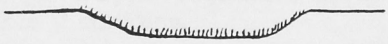
IMPORTANT POINTS IN FILLING GULLIES

THIS

PACK SOIL THOROUGHLY AS GULLY IS FILLED



LEAVE WIDE LEVEL BOTTOM



GRASS WELL UP ON SIDES OF WATER WAY

NOT THIS

SOIL LEFT LOOSE

A "V" BOTTOM FORCES WATER INTO NARROW CHANNEL

GRASS ONLY IN BOTTOM OF WATER WAY

GULLIES

The formation of gullies in a field is the final stage in accelerated water erosion. Usually gullies form in the natural drainage channels. Previous to being cultivated these channels were protected by grass and other growth which prevented erosion. Consequently, the obvious and practical thing to do when gullying first starts is to restore a grass cover to the drainage channel and thus prevent further erosion. Where a gully has formed it is necessary to fill it in before seeding it to grass.

In filling a gully, certain precautions are necessary to prevent a recurrence of the problem. (See graph on opposite page).

1. The soil used to fill the gully should be firmly packed. If this is not done the settling of the loose soil later on may cause a break in the grass cover and allow erosion to begin once more.

2. The bottom of the newly-formed channel should be flat and broad so as to spread out the water flow, thus reducing its erosive action. If erosion starts there is great danger of the water undermining the grassed portion of the channel and destroying the entire project.

3. The grass cover should extend well up on the sides of the newly-formed drainage channel. This is to prevent the water from a heavy run-off rising above the grassed channel, and eroding the unprotected soil at higher levels.

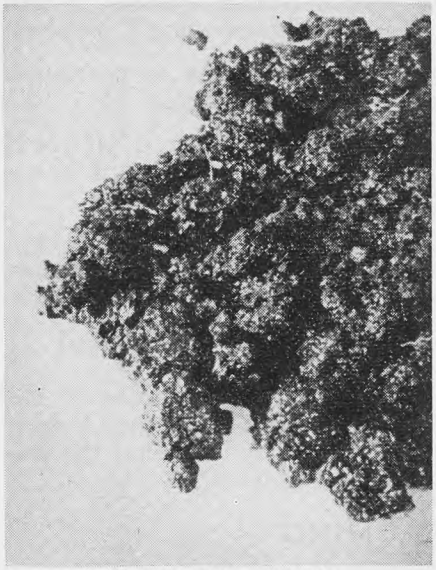
CONTOUR FARMING

Contour farming is an effective method of reducing water erosion on sloping land. It is suited to long, uniform slopes rather than to knobby, hilly land. Contour farming simply means that a field is farmed in strips at right angles to the slope. On gentle slopes the strips may be cropped in a straight grain rotation. On steeper slopes it is usually advisable to seed some of the strips to forage crops. The forage strips are often called "buffer" strips and have the effect of slowing down the rate of flow of run-off water. Contour farming has not been widely adopted in Western Canada. Those who have used it, however, are well satisfied with the results. In addition to controlling erosion it is claimed that there is a decided saving in power required to haul farm equipment on the contour compared with "up and down hill" farming.

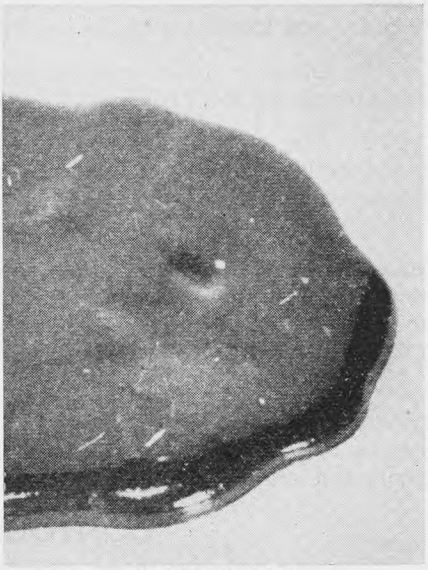
"HARD PAN" OR "PLOW SOLE"

In many areas of Western Canada farmers speak of 'hard pan' or 'plow sole.' Recently, the term "soil compaction" has been given to this problem. These terms refer to a hard, compacted layer of soil which occurs just below the depth of cultivation. This condition usually occurs on land that has grown cereal crops almost exclusively for many years. There are several factors which contribute to soil compaction. First of all, the fibre and organic matter in the soil have been largely destroyed through repeated cultivation and cropping, and puddle erosion has filled the natural open spaces in the soil with fine soil particles.

In addition, on the heavier soils particularly, the use of heavy machinery on the land while the sub-soil is wet, has had a tendency to compact the sub-tillage layer. The effect of this compacted layer on crop growth is two-fold. First, the soil cannot take in or hold moisture as it could originally. Secondly, proper root development is prevented. The result is reduced yields and accelerated water erosion.



SOIL OF GOOD TILTH



PUDDLED SOIL

Experimental work with compacted soils has indicated that breaking the sub-soil to a depth of not more than 8 inches with chisel points spaced 12 inches apart has given the most economical results. More experience with deep tillage in Western Canada is required before its value, under our conditions, can be properly assessed.

A point to be emphasized here is that deep tillage carried out when the subsoil is wet may aggravate the soil compaction problem instead of improving it. The deep tillage machine forced through a wet subsoil packs the soil below and to each side of the shanks. This defeats entirely the purpose of the operation. Don't work the subsoil when it is wet.

A much more economical approach to the problem would be to grow forage crops (grasses and legumes) which will open up the subsoil and improve the 'tilth' or 'structure' of the surface soil. (See page 19 on "Forage Crops").

MAINTAINING SOIL FERTILITY

No single soil management practice is more important in protecting our prairie soils than maintaining soil fertility.

COMMERCIAL FERTILIZERS

These have a very important place in western agriculture. While the prairie soils were initially quite well supplied with nitrogen and potash, the phosphate content has always been relatively low. Each crop grown in Western Canada removes a large quantity of plant food. And, as the greater part of each crop is exported, the annual drain on prairie soils is tremendous. In 1952, for example, cereal grains sold off the farms of Western Canada removed from the soil an estimated 620,000 tons of nitrogen, 295,000 tons of phosphate and 146,000 tons of potash. During the same year only 16,500 tons of nitrogen, 40,000 tons of phosphate and 26 tons of potash were returned to the soil in the form of commercial fertilizer. Such a heavy annual loss of plant food cannot continue without eventually lowering crop yields seriously.

Fertilizer tests conducted throughout the Prairie Provinces show that the application of ammonium phosphate fertilizers give yield increases of 20% to 25% or higher. It is only reasonable to expect, therefore, that as time goes on, the use of commercial fertilizer by prairie farmers will increase.

As fertilizer requirements vary greatly, farmers are advised to obtain information on this subject from local Provincial or Federal agricultural authorities.

FORAGE CROPS

So far in this bulletin the emphasis has been on the use of trash cover in controlling wind and water erosion. This was done because trash cover is a simple, easy and effective method of erosion control, generally available to most farmers in Western Canada. However, while invaluable in controlling erosion, the trash cover does not supply the fibre necessary to maintain proper soil structures or organic matter whereby a high state of fertility can be maintained.

The fibrous roots of the grasses have the power to tie the single grains of soil into granules and to improve the 'tilth' or 'structure' of the soil. Furthermore, the large tap roots of sweet clover or alfalfa penetrate compacted subsoils, provide subsurface drainage and increase the water-holding capacity of the soil. Both grasses and legumes return vital organic matter and humus to the soil.

In drier areas, forage crops may be difficult to grow. However, in the more humid areas, where water erosion especially is a serious problem, every farm rotation should include some forage crops. Good soil protection through the use of forage crops is the key to a profitable, permanent agriculture in the Prairie Provinces.

ASSISTANCE AVAILABLE

Your Agricultural Representative or District Agricultuirst, as well as the soil specialists of your Provincial Department of Agriculture and nearest Federal Experimental Farm, will be glad to help you with your soil problems. You can also get valuable assistance in studying the soils and soil protection problems on your own farm from the Soils Department of your provincial University.

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